Prepared For:
The United States Agency for International Development (USAID)
Global Climate Change Team

CLIMATE TECHNOLOGY PARTNERSHIP (CTP)

Improved Energy Efficiency in the Industrial and Commercial Sectors in Egypt

FINAL PROJECT REPORT

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Nexant

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United States Agency for International Development/Cairo Mission
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Support Task Order

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- **Project Background, Scope and Objectives**

This final project report summarizes the activities undertaken by Nexant Inc. in Egypt in support of the Climate Technology Partnership (CTP), a bilateral initiative between the US and several developing countries including Egypt. This work order was initiated to continue the efforts that the USAID Global Climate Change Team had initiated to mitigate Greenhouse Gas (GHG) emissions. Nexant has identified an opportunity to promote the cost-effective use of the cogeneration technology in the Egyptian commercial and industrial sectors with that promises a widespread replication.

Hilton Pyramids Golf Resort in the City of 6th of October (30 kilometers from downtown Cairo) was selected to implement a pilot cogeneration installation provided by the Egypt Kuwait Holding Company (EK Holding), an investment group with proven track record in energy investments. The project scope included assistance from Nexant to Hilton and EK Holding to facilitate the implementation of a replicable project. Nexant provided support in investigating the project feasibility, developing a monitoring and verification plan, and developing a typical contract to govern the business relationship between the project players. Additionally, Nexant helped coordinating the project outcome to the relevant stakeholders within the Egyptian Government.

- **Technical and Economic Assessment**

Nexant developed a plan to investigate the technical and economic feasibility of the project as well as to identify all related legal issues. Nexant also secured the support of the Egyptian Electric Utilities Consumer Protection Agency to ensure this agency's support.

Several cogeneration unit sizes and configuration were evaluated leading to a recommendation to use a 480-KW unit to supply partial load with two options. The first is based on operation on a separate load inside the hotel, with the utility supply as backup through an automatic transfer switchgear. The recovered heat would be used for domestic water heating. The second option is based on operating in parallel with the utility supply, thus increasing the overall efficiency of the system.

The analysis indicated that an acceptable return to EK Holding (25% IRR) could be achieved with a reasonable annual operational savings to Hilton of LE 91,460 without an upfront investment. With a total investment of LE 1,787,000, EK Holding would need to establish a sale price structure of electricity to Hilton, over the life of the contract, through a formula that addresses exchange rate and the cost of natural gas. Therefore, Nexant developed a formula that meets the investment objectives of EK Holding while yielding a lower price of electricity than otherwise provided by the national electric grid. The formula resulted in an average cost per kWh for Hilton of LE 0.181 with the current exchange rate and gas price, which is more than 10% below the average cost of buying from the utility national grid (LE 0.202 per kWh).

However, approximately a 30% increase to natural gas rates for industrial and power generation facilities was announced two weeks prior to the finalization of this report. This recent change provided a major economic challenge for cogeneration projects in absence of a similar increase in electricity rates. The new gas price will yield an average cost of electricity to Hilton of LE 0.196 per kWh, which is marginally less than the cost of buying power from the national utility grid. This increase will result in a lower overall annual operational savings for Hilton from LE 91,460 to LE 35,000.

Scenario	Consumption kWh	Elec. Demand kW	Elec. Savings	Hot Water Savings	Total Savings
Basecase	5,350,000 kWh	1,100 kW	NA	NA	NA
480 KW Cogeneration with old Gas Price	3,760,000 kWh	620 kW	LE 78,960	LE 12,500	LE 91,460
480 KW Cogeneration with new Gas Price	3,760,000 kWh	620 KW	LE 22,500	LE 12,500	LE 35,000

Table 1-1 Projected System's Economics

- **Measurement and Verification Protocol**

To support the ongoing power purchase activities between Hilton and EK Holding, Nexant developed a simple and transparent monitoring and verification plan that helps verify the operational savings that Hilton would realize as a result of installing the cogeneration unit. The plan also accounts for the electric and thermal performance of the existing operation, and provides means to measure and calculate future operational savings. Other factors that are not influenced by the technical ability of the cogeneration system such as occupancy levels, weather fluctuation, and resort utilities performance are also addressed in the plan. The protocol will be used as an integral part of the contract between Hilton and EK Holding.

- **Power Purchase Model Contract**

Nexant applied the legal expertise of its subcontractors in defining the key elements that should be documented to govern the relationship between both EK Holding as a seller of power, and Hilton as a buyer. A proposed power purchase model contract was developed, defining the responsibilities and obligations of the parties, including operational criteria, calculations methods, payment terms, ownership of equipment, taxes, and other related business and legal issues.

- **Final Project Workshop**

On May 10th, Nexant facilitated a final workshop for all stakeholders to review the out come of the project materials for future implementation.

Section 2 – Technical and Economic Assessment

2.1 BACKGROUND

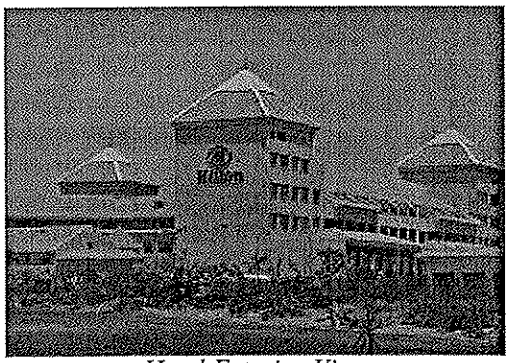
This report summarizes the activities undertaken by Nexant Inc. in Egypt in support of the Climate Technology Partnership (CTP), a bilateral initiative between the U.S. and several developing countries including Egypt. This work order was initiated as part of the Support Task Order of the Energy Indefinite Quantity Contract (IQC) to continue the efforts that the USAID Global Climate Change Team had initiated to mitigate Greenhouse Gas (GHG) emissions. Nexant has identified an opportunity to promote the cost-effective use of the cogeneration technology that promises a widespread replication in the Egyptian commercial and industrial sectors.

Nexant was a prime candidate for providing project assistance for 2 main reasons: 1) its local presence providing technical assistance to the USAID mission in Cairo on energy efficiency policies, and 2) the synergy that existed between the objectives of the 2 projects. The work order was initially issued in November 2002 for an industrial application, but limited progress was achieved due to the lack of interest on behalf of the project local counterparts.

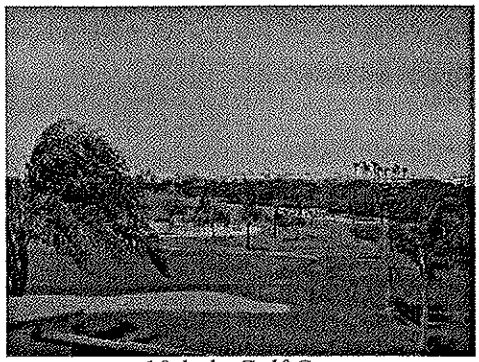
In mid 2003, the work order was modified to change the focus to the tourism sector given its fast growth trend and the pressure it represents on the power industry. Nexant was able to secure the interest of the Hilton management to use cogeneration at their Hilton Pyramids Golf Resort in the City of 6th of October. The scope included assistance from Nexant to Hilton and to the Egypt Kuwait Holding Company (EK Holding), an existing energy investor group with interest in small power generation. Nexant's scope was to examine the economics of the project, develop a monitoring plan, and to help the stakeholders in producing a legal instrument that can be used to facilitate the power purchase activities over the life of the contract.

2.2 HOTEL GENERAL INFORMATION

Hilton Pyramids
Golf Resort is a 229-room five stars hotel located in the in the City of 6th of October a satellite city approximately 30 kilometers from downtown Cairo. It was opened in 2002 to support the growth of the new city and to take advantage of its proximity to the most popular tourist are around the Giza Pyramids, and to the new Media City. The resort is built on approximately 12 acres and it includes an 18-hole championship golf course, 2 restaurants, one bar and a lounge.



Hotel Exterior View



18-hole Golf Course

2.3 HOTEL ENERGY PROFILE

A comprehensive energy audit was conducted in 2002 during the soft opening of the hotel, and several recommendations were made to increase the efficiency of the energy systems, including a retrofit of incandescent lighting with compact fluorescent lamps and electronic ballasts, an increase to the power factor, replacement of electric heaters with hot water coils, and the installation of a 500-kW cogeneration unit to operate in parallel with the utility grid.

The hotel management and engineering staff had already implemented some of the above recommendations including the installation of capacitor banks and handling some loads redistribution in order to improve the power factor and harmonics level of the hotel. They also completed the commissioning of the energy management systems for heating, ventilation, and air conditioning systems (HVAC). While no action was taken to install a cogeneration unit, Hilton remained interested in evaluating its options in this area to reduce operating costs.

2.3.1 ELECTRIC ENERGY CONSUMPTION

The hotel utilizes both electricity and fuel for its energy needs. Electrical energy is used as the prime power for the hotel's utilities, and for lighting and space conditioning. Domestic hot water needs are heated with natural gas, which is available through the Local Distribution Company: Natgas. Annual electric consumption is approximately 5,250,300 kWh costing the hotel in excess of one million Egyptian pounds. With a peak demand of 1,100 kW, the hotel load factor is less than 56%.

As shown in Table 2-1 and Figure 2-1 below, the average monthly consumption is approximately 446,000 kWh, and the average monthly electric bill is around LE 90,000, yielding an average cost per kWh of LE 0.202.

Month	Electrical Energy Consumption (kWh)	Electricity Costs (LE) Due to			Average Cost of Consumption (LE/kWh)
		Energy Consumption	Demand Charge	Total	
Aug-02	206,300	37,856	8,030	45,886	0.22
Sep-02	154,800	28,406	8,030	36,436	0.24
Oct-02	318,690	58,480	8,030	66,510	0.21
Nov-02	502,690	92,244	8,030	100,274	0.20
Dec-02	551,520	101,204	8,030	109,234	0.20
Jan-03	719,320	131,995	8,030	140,025	0.19
Feb-03	673,450	123,578	8,030	131,608	0.20
Mar-03	709,330	130,162	8,030	138,192	0.19
Apr-03	519,210	95,275	8,030	103,305	0.20
May-03	447,480	82,113	8,030	90,143	0.20
Jun-03	220,610	40,482	8,030	48,512	0.22
Jul-03	326,900	59,986	8,030	68,016	0.21
Total	**5,350,300**	**981,780**	**96,360**	**1,078,140**	
Average	**445,858**	**81,815**	**8,030**	**89,845**	**0.206**

Table 2-1 Electricity Consumption and Associated Costs

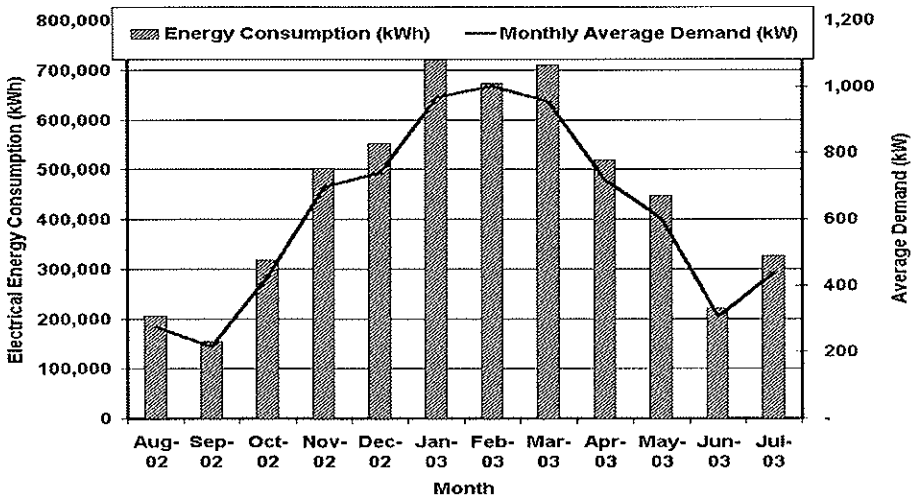


Figure 2-1 Average Electric Energy Consumption and Peak Demand

2.3.2 NATURAL GAS CONSUMPTION

Table 2-2 below provides the monthly gas consumption for the period Aug 2002 to July 2003, with a total annual consumption of 104,000 cubic meters and a total cost of LE 35,000. Figure 2-2 below, provides a monthly illustration of generated hot water and the hotel thermal load in cubic meters.

Month	Cost (LE)	Natural Gas Consumption (m^3)
Aug-02	2,176	6,495
Sep-02	2,254	6,721
Oct-02	2,652	7,905
Nov-02	2,574	7,673
Dec-02	3,271	9,751
Jan-03	3,622	10,799
Feb-03	3,155	9,408
Mar-03	3,941	11,749
Apr-03	3,707	11,045
May-03	3,256	9,702
Jun-03	2,362	7,007
Jul-03	2,038	6,045
Total	**35,007**	**104,300**

Table 2-2 Natural Gas Consumption and Associated Costs

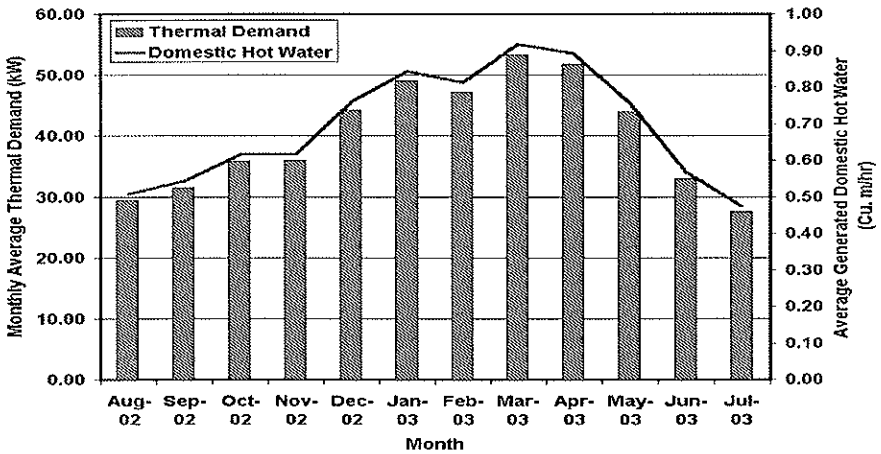


Figure 2-2 Monthly Natural Gas Consumption

2.3.3 SITE MEASUREMENTS

Four electrical energy meters were installed on Oct 10,2003 to record the load profile of the hotel as follow:

- Main distribution panel # 1 connected to the secondary side transformer # 1 (capacity = 2 MVA)
- Main distribution panel # 2 connected to the secondary side of transformer # 2 (capacity = 2 MVA)
- Load center of vapor compression chillers
- Load center of supply and return chilled water and cooling towers.

The above two mentioned load centers are connected to transformer #1. Actual loads were recorded over a 10-day period, and Figure 2-3 illustrates an example recorded electric demand for the period Oct 10-20. Total measured data at the site is documented in Appendix 1.

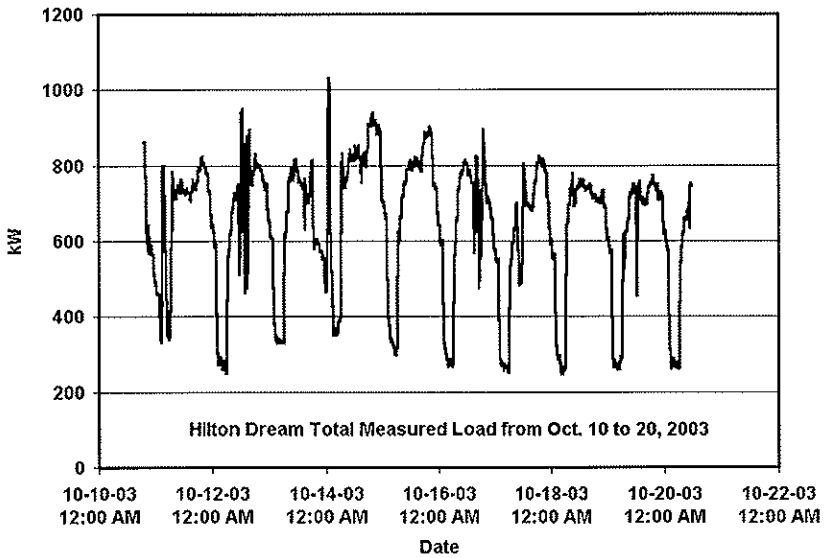
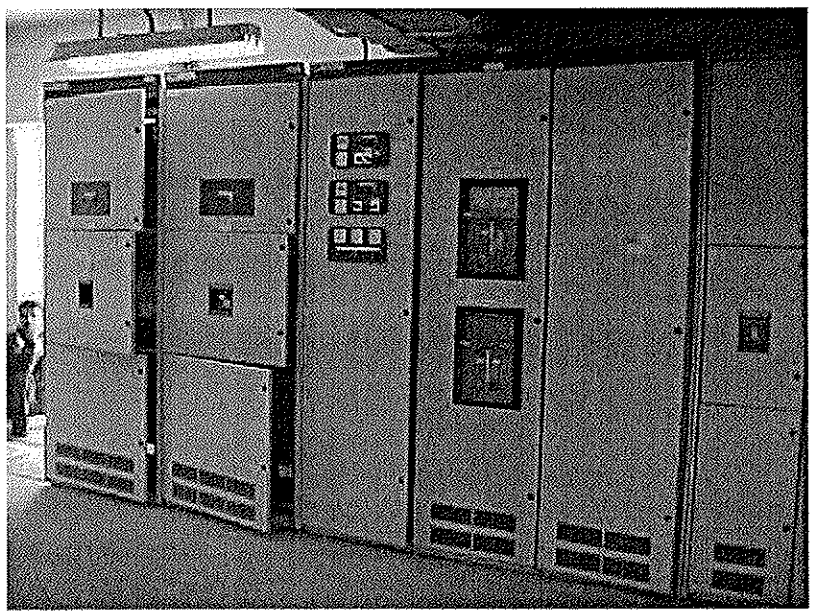


Figure 2-3 Daily Hotel's Electric Load Profile During the Measurement Period



2.3.4 LOAD DURATION CURVE

The load duration curve illustrates the number of hours in the year (X axis) that the peak load reading (Y axis) is recorded. For example, as shown in Figure 2-4 below, the peak load never dropped below 215 kW any time in the year, but has reached 400 kW for just under 7,000 hours. This figure is based on actual data taken from the utility bills for a period of one year. The maximum-recorded demand in that period was 1,002 kW, which is very close to the maximum demand of 1,100 KW that was reported by the utility meter. Actual site measurements were taken every hour during the period October 10-20 to validate the data extracted from the utility bills.

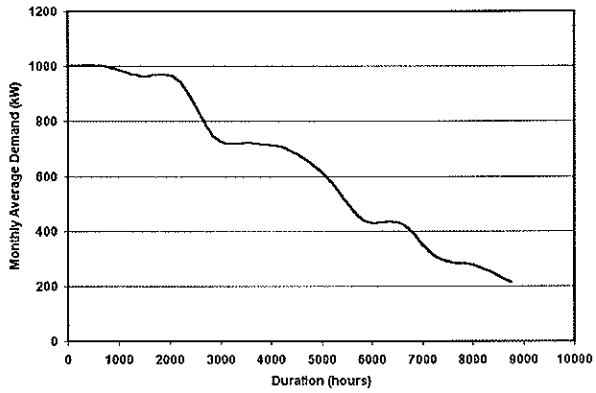


Figure 2-4 Hotel Load Duration Curve (form Utility Bills)

Figure 2-5 provides the hourly peak demand recorded at the site. The curves in this figure are closely matching the load duration curve of the utility bills with a deviation ranging between 1% and 15%. This match provides a good indication that daily measurements could be accurate representation of the system's needs, and hence can be used to size the cogeneration unit. The load duration curve of Oct 14, 2003 (Figure 2-6) was considered a typical curve for the hotel for annual calculation purposes.

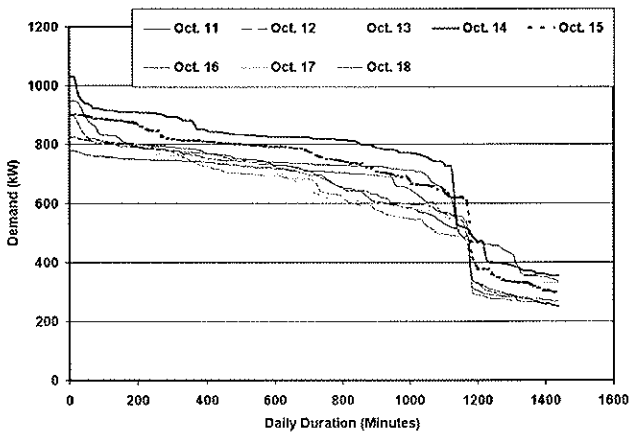


Figure 2-5 Hotel Daily Load Duration Curves (based on Site Measurements)

Both load duration curves of daily measurement of Oct. 14, 2003 and utility bills are presented in figure 2-7 indicating similarity in load pattern.

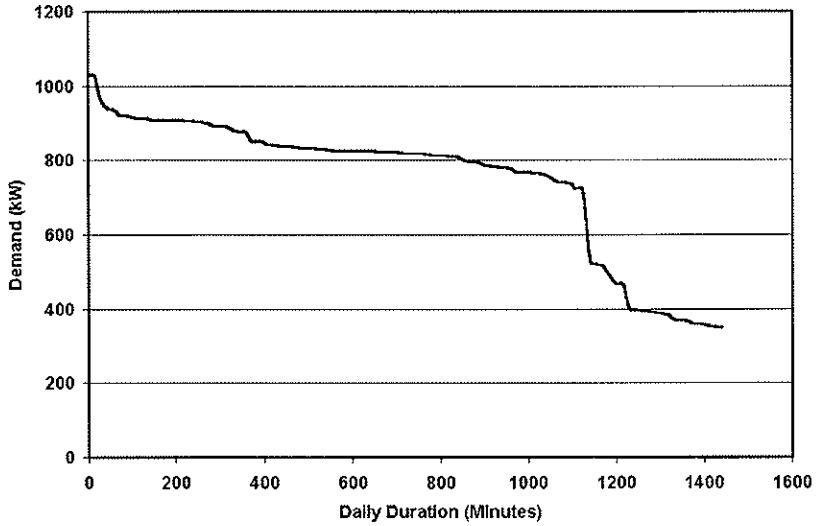


Figure 2-6 Hotel Daily Load Duration Curve of Oct. 14, 2003

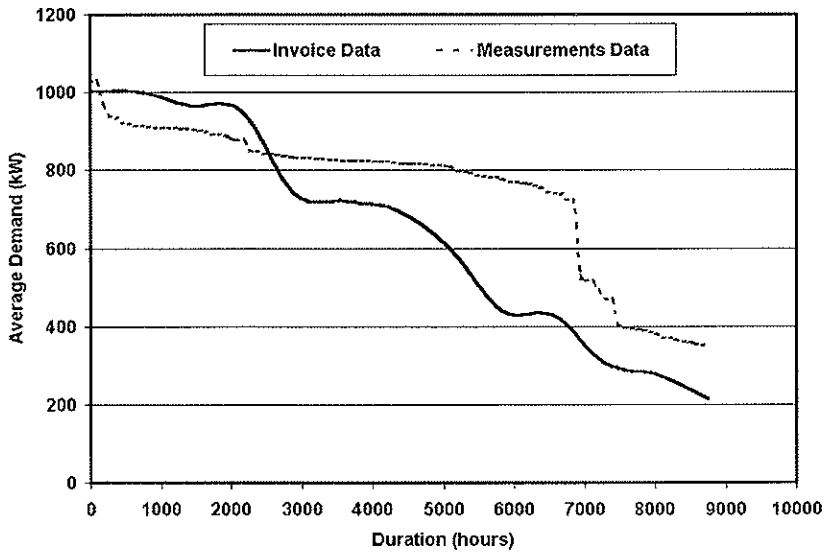


Figure 2-7 Hotel Load Duration Curves based on Measurements and Bills

2.4 COGENERATION SYSTEM SIZING

The proposed cogeneration system is a reciprocating gas engine generator with waste heat recovery system that utilizes the recovered heat from the engine cooling system (Jacket Water) to heat domestic water. The Hotel's maximum demand of 1,100 KW implied the need for two 600-KW gas engine driven generators to meet such demand. However, with a low load factor of 62%, the return on investment for this option was not attractive. Several evaluations were conducted in search of an economically feasible setup for the cogeneration unit, and the result was the selection of a one 480-KW gas engine generator.

The average load duration curve, illustrated in figure 2-8 below, indicates that the selected 480-kW cogeneration unit will cover approximately 70% or 3,760,000 kWh of the total annual consumption of 5,350,000 kWh. The generated electricity represents 90% of the unit's maximum production capacity, which increases its operational efficiency. In addition the above economic utilization of the generator, a waste heat recovery system could be installed to recover heat from the engine cooling system (Jacket water) to generate domestic hot water. The remaining 30% will be supplied by the electric utility grid through a synchronization panel equipped with load share controller to maximize the use of the unit.

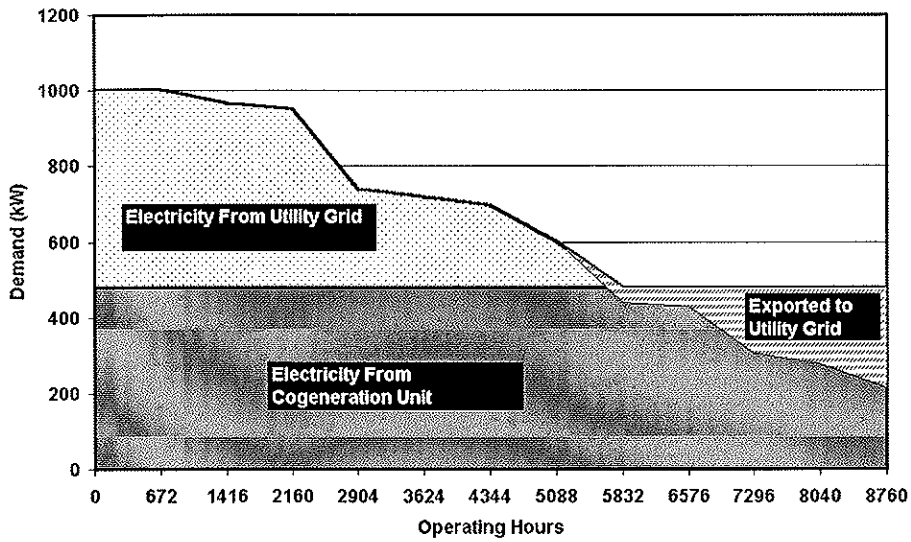


Figure 2-8 Cogeneration and Resort Load Duration Curve

Figure 2-9 represents the proposed connection configuration of the cogeneration unit with the utility grid. It shows the following:

- Gas engine driven generator with out put capacity of 480 KW
- Heat exchanger for recovering the jacket water heat

- Synchronization panel with a load share controller for parallel operation with the utility grid

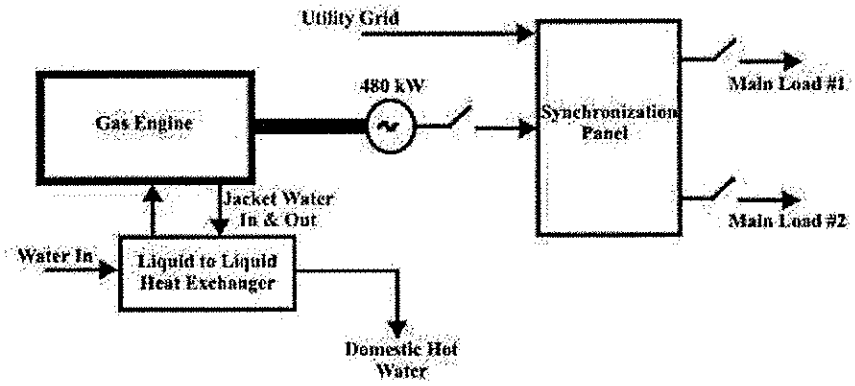


Figure 2-9 Proposed Connection Configurations

2.5 FINANCIAL ANALYSIS

2.5.1 INVESTMENT COST

The following cost items were calculated based on the effective[1] currency exchanged rate that EK Holding uses of LE 6.40 per USD, and on duties and Sales Tax combined rate of 18%.

• Natural Gas internal network upgrade	LE	77,200
• Gas driven generator	LE	1,427,400
• Waste heat recovery equipment	LE	90,000
• Design, engineering and civil work	LE	192,400
Total Investment Cost	**LE**	**1,787,000**

2.5.2 FINANCING STRUCTURE

Based on information provided by EK Holding, the project would be financed through an Equipment Lease Purchase. The leased equipment would be the cogeneration unit (LE. 1,427,424) and the waste heat recovery equipment (LE 90,000), while the remaining expenses would be covered by equity. Leasing terms are as follows:

▪ Purchase Cost (Equipment Only)	LE	1,517,400
▪ Up- front payment		10%

[1] Effective exchange rate accounts for the official exchange rate plus other administrative fees related to the transaction.

- Leasing period 5 Years
- Payment terms Monthly payment
- Average Interest 17%

According to the above terms, the capital structure will include a paid equity (natural gas network + pre-operating expenses + 10% Lease upfront payment) and a lease portion, which is 90 % of the equipment cost.

- Paid Equity (10% down payment, gas network, & engineering work) LE 421,096
- Leasing Amount LE 1,365,681

2.5.3 ANNUAL OPERATING COST

The annual operation and maintenance expenses were calculated according to the technical specifications of the equipment and normal engineering standards.
The useful life of the cogeneration plant is considered to be 15 Years. All maintenance and overhauling costs are US dollar based using the effective exchange rate of 6.40 LE/USD, while the manpower and over-heads cost is based on local currency. The average annual cost per kWh is therefore:

▪ Natural Gas Cost	LE	0.0434
▪ Oil Change	LE	0.0039
▪ Maintenance and Spare parts	LE	0.0102
▪ Overhauling	LE	0.0179
▪ Man power and Over-Heads	LE	0.0189

Total cost per kWh is	LE	0.0943

2.5.4 POWER PURCHASE PRICE FOR ELECTRICITY

The suggested rate structure for EK to use in selling power to Hilton includes a Demand Charge per KW and an Energy Rate per kWh. Demand charges cover the fixed expenses that are independent from the generation capacity (manpower, part of maintenance, and overhauling). The energy rate covers the variable expenses that are dependent on generation capacity (fuel cost, oil change and the major part of maintenance and overhauling expenses). The proposed formula includes:

- Demand Charge = LE 15.00/KW per Month, plus
- Energy Charge = 0.0825 LE/kWh + ($0.005 per kWh x Exchange Rate) + (N.G price in LE/m^3 x 0.31 m^3/kWh)
  Where $0.005 is a factor to account for foreign currency related expenses such as spare parts & overhauling.

Using an exchange rate of 6.15 LE/USD, and LE 0.141/ m^3 for natural gas, the average energy price would be 0.1575 LE/kWh, in addition to the demand charge, which translates to an overall average rate of LE 0.181/kWh.

2.5.5 PURCHASE PRICE FOR HOT WATER

The hotel is currently using natural gas for its water heating needs using approximately 104,000 m^3 of natural gas with an annual cost of LE 35,000. With a total consumption of 18,000 m^3 annually, the average cost of heating water is LE 1.95 per cubic meter. With the cogeneration operation, the cost of heating water would be limited to the cost of O&M of the heat exchanger, which is estimated at LE 6,000 per year. The hot water price (Fuel only excluding cost of water) will then be 1.25 LE/m^3.

2.5.6 ECONOMIC ANALYSIS FOR EK HOLDING

- Annual revenues
  - o Electric energy LE 592,200
  - o Electric Demand LE 86,400
  - o Hot Water LE 22,500

  Total anticipated annual revenues LE 701,100
- Average Annual Expenses LE 479,700
- Investment Cost LE 1,787,000
- Paid equity LE 421,096

Based on the above, the following, EK Holdings's IRR is then 25%, with a NPV of LE 268,000 (18% discount rate).

2.5.7 ECONOMIC ANALYSIS FOR THE HILTON HOTEL

Since Hilton is not contributing an upfront investment in this project, the only economic measure would be the annual operational savings, which can be calculated as follow:

Pre-project average electricity cost	0.202 LE/kWh
Post-project average electricity cost	0.181 LE/kWh
Savings per kWh	0.021 LE/kWh
Electricity purchased from IPP	3,760,000 kWh/Year
Annual savings in electric bill	*LE 78,960*
Pre-project annual hot water cost	LE 35,000
Pre-project hot water cost	1.95 LE/ m^3
Post-project hot water price	1.25 LE/m^3
Average annual consumption	18,000 m^3
Post-project annual cost	LE 22,500
Annual Savings	*LE 12,500*
Hilton's annual operational savings	*LE 91,460*

2.5.8 ECONOMIC ANALYSIS FOR THE HILTON HOTEL (UNDER NEW GAS RATES)

In March 2004, the government of Egypt increased the cost of natural gas provided to industrial and power generation users and sectors, and further tied it the US dollar (USD 0.85 per 1,000 ft^3). Using the current exchange rate of 6.15 LE per USD, the equivalent price will be 0.185 LE/m^3 instead of 0.141 LE/m^3 used in this evaluation. Accordingly, the adjusted electricity generation cost will be:

▪ Fuel Cost	LE	0.0570
▪ Oil Change	LE	0.0039
▪ Maintenance and Spare parts	LE	0.0102
▪ Overhauling	LE	0.0179
▪ Man power and Over-Heads	LE	0.0189

Total cost per kWh is	LE	0.1079

To maintain the same level of return to EK Holding for this project (25% IRR), the pricing formula for power purchase to Hilton will need to be adjusted to the following:

- Demand Charge = LE 15.00/KW per Month, plus
- Energy Charge = 0.0825 LE/kWh + ($0.005/kWh x 6.15) + (LE 0.185 x 0.31)
  Where $0.005 is a factor to account for foreign currency related expenses such as spare parts & overhauling.

The new gas rates will result in an average energy price of 0.1706 LE/kWh, in addition to the demand charge, for an overall average energy cost of LE 0.196/kWh. Obviously, the annual operational savings for Hilton will be reduced as follows:

Savings before Natural Gas price Increase	LE 91,460 per Year
Savings after Natural Gas price increase	LE 35,000 per Year

Section 3 – Measurement and Verification Protocol

3.1 APPROACH AND METHODOLOGY

This proposed M&V protocol is established to facilitate the process of monitoring the system's performance and verify the projected savings that will result from the installation of the cogeneration unit. The protocol provides an easy and transparent method of calculating the monetary savings, as well as to document the performance of the installed system. Historically, M&V efforts were critical steps in ESCO type activities (performance-based projects). A proper and well-designed M&V plan that strikes a balance between the client's interest in energy specific issues, and the accuracy that is needed to verify project results often leads to a successful project where both the client and the ESCO are working together to realize their benefits. Conversely, a complicated and a difficult to understand plan that favors engineering accuracy over business common sense, could lead to a division of interest between parties and turn the project into a controversial scheme.

M&V plans also provide the means for clients to increase their awareness of how their energy systems perform and allow them to take proper actions independent of monetary savings. In a hotel environment, the management company's most critical issue is customer's comfort and satisfaction to ensure a repeat business. The M&V protocol is a hands-on training for hotel engineering staff to further their knowledge on required adjustments that could increase comfort.

In this project, EK Holding will act as an independent power provider selling power and energy to Hilton. The operational savings is expected to materialize as a result of purchasing power at a lower rate than available from the national electric grid, and not due to a reduction in energy consumption at the end use. However, the increase in the of generation efficiency will result in a reduction in GHG emissions.

3.2 SAVINGS CALCULATIONS

The expected savings from the installation of the cogeneration system at Hilton will be calculated using the following methodology:

3.2.1 *ELECTRIC SAVINGS*

*Savings = Energy Consumption from IPP * (Utility Energy Rate – IPP Energy Rate)*
+ Electric demand (Utility Demand Rate – IPP Demand Rate)
+ Adjustments

Where:

Energy Consumption from IPP:	is the energy consumed by the client and supplied from the cogeneration unit -- measured in kWh.
Utility Energy Rate:	is the declared utility rate in LE / KWh

	(currently at LE 0.1835 / kWh)
IPP Energy Rate:	is the contracted energy rate as agreed to in the Power Purchase Contract in LE / kWh.
Electric Demand:	is the power demand of facility from the cogeneration unit -- measured in KW.
Utility Demand Rate:	is the declared utility rate in LE / KW / month (currently at LE 7.30 / KW / month)
IPP Demand Rate:	is the contracted power demand rate as agreed to in the Power Purchase Contract in LE / kW.
Adjustments:	is defined as the aggregate sum of the monetary adjustment as a result of penalties imposed on the IPP due to possible deviation from the established performance parameters.
Adjustments =	*S (Penalties paid by IPP) - (Penalty paid by facility).*

3.2.2 *THERMAL SAVINGS*

*Savings = Volume of Hot Water supplied * (Heating cost by Boiler – IPP Rate) + Adjustments.*

Where:

Volume of Water Supplied:	is the volume of water supplied by IPP, in cubic meters
Heating Rate by Boilers:	is the Basecase cost of water heating, which was calculated to be LE 1.95 per cubic meter of water. (This value is dependent on the natural gas price and should be revised accordingly.
Adjustment:	is the penalty paid for temperature decrease from the agreed difference in temperature or ?T (?T is 50 °C unless agreed to otherwise).

3.3 MEASUREMENTS

To ensure that the system's performance is documented properly, the measurement setting of electrical and thermal loads have to be defined. Figure 3-1 represents the connection configurations for the cogeneration system and the utility supply to the facility through a synchronization panel with load share controller. The diagram shows the location of the meters that should be used measure electricity and thermal energy.

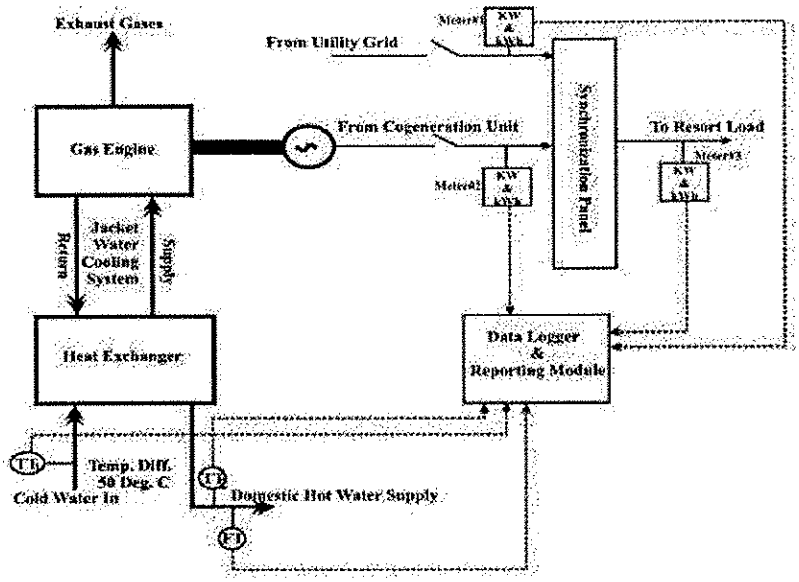


Figure 3-1 Proposed Monitoring Meters Configurations

3.3.1 *ELECTRICAL ENERGY DATA*

All electric meters (M1, M2 & M3) transmit readings to the Data Logger on energy consumption (kWh), energy demand (KW), frequency (Hz), power factor, voltage (volts) and harmonics if required.
Where:

Meter # 1: reads data from the utility grid
Meter # 2: reads data from the cogeneration unit
Meter # 3: reads data from the facility side

3.3.2 *THERMAL ENERGY DATA*

TT1: reads and transmits readings to the Data Logger - temperature of the inlet water to the heat exchanger in °C.

TT2: reads and transmits readings to the Data Logger - temperature of the feed hot water going to the facility from the heat exchanger (outlet) in °C.

FT: is a flow meter that reads and transmits the flow rate of hot water supplied to the facility in m^3/hour.

3.3.3 *DURATION & CALIBRATION*

It is anticipated that both parties will agree on the periodical readings and recording of data for calculation purposes. The Data Logger will receive the readings from all meters and register it for report production on a pre-set basis. The selection of meters accuracy and calibration will be a joint decision by both parties.

Section 4 – Power Purchase Model Contract

Nexant applied the legal expertise of its subcontractors in defining the key elements that should be documented to govern the relationship between both EK Holding as a seller of power, and Hilton as a buyer. A proposed power purchase model contract was developed, defining the responsibilities and obligations of the parties, including operational criteria, calculations methods, payment terms, ownership of equipment, taxes, and other related business and legal issues. A proposed power purchase contract is included in this section.

Energy Power Purchase Contract Proposed for Cogeneration Project at the Hilton Pyramids Golf Resort

This power purchase agreement (hereinafter referred to as the "Agreement") was entered into on this **xxxxx** day of **xxxxx**, 2004 (hereinafter referred to as the "Effective Date") by and between:

1. **xxxxx** Company, an Egyptian **xxxxx** company established under Law No. **xxxxx** of **xxxxx**, registered with the **xxxxx** Commercial Registry under number **xxxxx**, with principal place of business at **xxxxx**, (hereinafter referred to as the "Supplier"), and
2. **xxxxx** of **xxxxx**, registered with the **xxxxx** Commercial Registry under number ....., with principal place of business at **xxxxx**, (hereinafter referred to as the "Purchaser")

both parties to this Agreement having each declared their intention and legal capacity to enter into this Agreement have agreed as follows:

Preamble

Whereas the Supplier is a leading Egyptian company specialized in the distribution and delivery of gas generated power to businesses and households, and

Whereas the Purchaser is a commercial establishment specialized in **xxxxx**, and

Whereas the Purchaser wishes to enter into an agreement whereby the Supplier constructs a cogeneration unit on the Purchaser's premises in order to supply the Purchaser with its power and energy requirements, and the Supplier has so accepted on the terms and conditions of this Agreement,

Now Therefore, the parties to this Agreement (hereinafter referred to as the "Parties") have agreed as follows:

Article One – Preamble and Annexes

The preceding Preamble and the Annexes attached to this Agreement shall all form and be considered integral parts thereof.

Article Two – The Land

The Supplier shall rent a piece of land (hereinafter referred to as the "Land") from the Purchaser, which Land is further described in detail in Annex (A) to this Agreement

throughout the term of this Agreement for consideration equal to LE **xxxxx** (**xxxxx** Egyptian Pounds) per year, payable every year in advance.

The Purchaser shall make the Land available to the Supplier and will allow the Supplier to take possession thereof on the Effective Date.

Article Three – The Cogeneration Unit

The Supplier shall, within **xxxxx** from the Effective Date, build on the Land a Cogeneration unit (hereinafter "Unit") whose production capacity is equal to **xxxxx**, on the basis of the project description and technical specifications described in Annex (B) to this Agreement. The Supplier shall allow the representatives of the Purchaser to inspect the progress of work and testing of the Unit.

The Supplier shall build the Unit together with all its requirements, rooms, machinery, equipment, installations, supply lines, connections to the public power distribution grid until the Unit and other requirements (all hereinafter referred to as the "Components") at its own cost.

The Supplier shall be responsible for obtaining all licenses, permits and authorizations required from any public or private authority or entity for the construction and operation of the Unit and for maintaining all such licenses, permits and authorizations valid at all times. The Purchaser undertakes to provide the Supplier with any necessary assistance and documentation which may be required in order to obtain and renew such permits, licenses and authorizations. The Supplier shall keep in the Unit originals or copies of all licenses which are required to be kept on premises of energy generating units.

The Unit and all its requirements as described above shall continue to be owned, operated, maintained and supervised by the Supplier throughout the term of this Agreement.

The Purchaser shall permit and allow the Supplier's employees, personnel, consultants and appointed contractors access to the Land during the construction period of the Unit and throughout the term of this Agreement at all times of the day, all days of the year, provided that the Seller undertakes its best effort to avoid ay disruptions in the Purchaser's ordinary business as a result of accessing the Land.

Article Four – Power and Energy Purchase

The Purchaser hereby agrees and undertakes to purchase from the Supplier, and from no other source except as made available by Supplier a minimum annual quantity of electrical energy generated by the Unit equal to **xxxxx** and a minimum hot water quantity of **xxxxx** (hereinafter referred to as "Minimum Take"), without prejudice to its rights to purchase additional power from the Supplier. Payment for purchased power

whether within the limits of the Minimum Take or for additional amounts shall be based on the Rate Structure and price formula (hereinafter "Rate and Price ") defined and described in Annex (C) to this Agreement.

The Purchaser shall establish on its premises – and allow employees of the Supplier access to – a measurement and verification unit based on the technical specifications and methodology described in Annex (D) to this Agreement.

The Purchaser shall provide the Supplier upon entering into this Agreement a revolving letter of guarantee issued by a first class reputable Egyptian bank covering the Minimum Take for the first year valid for **xxxxx** years from the Effective Date.

Article Five – Undertaking to Supply

The Supplier hereby undertakes to provide the Purchaser with a reliable and continuous source of power from the Unit from the date of supply (hereinafter "Supply Date") in a quantity of no less than **xxxxx** and according to the agreed specifications as stipulated in Annex (X) to this Agreement. Failure by the Supplier to supply the required power at any time shall allow the Purchaser to purchase its power needs from sources other than the Unit at the expense of the Supplier, without prejudice to any other damages that it may incur as a result of power shortages or failures. The Supplier, in performing its obligations under this Agreement, shall be entitled to supply the Purchaser with power generated by other than the Unit provided that the Purchaser shall continue to be charged on the basis of the Rate and Price referred to in Article Four of this Agreement and described in Annex (C) thereof.

Article Six – Undertaking to Purchase

The Purchaser hereby undertakes to purchase every year the minimum amount of power hereinabove referred to as Minimum Take, with payment made at the end of every month based on actual supply. Should the Purchaser fail to purchase and pay for the Minimum Take in any year than the Supplier will be entitled to disconnect the power supply, remove the Unit from the Land, liquidate the letter of guarantee referred to in Article Four of this Agreement, all without prejudice to any additional damages that may be due to it as a result of such breach of agreement.

Article Seven – Purchase Option

At the end of the term of this Agreement,, and provided that the Purchaser has not breached its obligations under this Agreement to pay for the Minimum Take in accordance with Article Four thereof, the Supplier shall transfer to the Purchaser the Unit and all Components in a working condition for a price of LE1.00 - (One Egyptian Pound). The Purchaser shall thereafter be responsible and pay for the operation, insurance and maintenance of the Unit, and any arrangement for the Supplier's continuing

involvement in the operation or maintenance of the Unit or in supplying energy to the Purchaser shall be governed by agreements to be entered into between the Parties.

Article Eight - Term and Termination

This Agreement shall come into force and be effective on the Effective Date and last for **xxxxx** years thereafter. Any of the Parties may terminate this Agreement in case of material breach of obligations by the other Party and following a ten day notice and the failure of that other Party to rectify the breach. This shall be without prejudice to the remedies offered to each of the Parties for breach of agreement in this Agreement.

The Agreement shall be automatically extended for additional identical period of time unless any one of the Parties informs the other of its intention not to renew it at least six months prior to the expiry of the term of Agreement.

Article Nine – Annexes

The Annexes attached to this Agreement and forming part thereof are the following:

Annex (A) The Land Description.
Annex (B) The Power Generation Unit.
Annex (C) Power Price Formula.
Annex (D) Measurement and Verification Specifications

Article Ten – Other Covenants

1. The fulfillment of obligations under this Agreement prior to, during and following the construction of the Unit shall be without prejudice to the provisions of the Egyptian Civil Code concerning force majeure.

2. The Supplier shall be held harmless from any damage caused as a result of its implementation of this Agreement, except if such damage is attributed to its – or any of its employees, officials or representatives – gross negligence or breach of regulations.

3. The Supplier shall keep and pay for an insurance policy covering any damage that may occur as a result of the operation or malfunction of the Unit, as well as covering the safety of the Unit itself throughout the term of this Agreement.

4. This Agreement shall be governed by and construed in accordance with Egyptian Law. Any dispute that may arise out of the application, construction, interpretation or termination of this Agreement shall be finally settled by arbitration in accordance with the rules of, and under the auspices, of the Cairo Regional Center for International Commercial Arbitration by a panel of

three arbitrators. The place of arbitration shall be in Cairo and the language of arbitration shall be the English language.

Article Eleven – Nature of Relationship

This Agreement sets the terms and conditions for the cooperation and mutual obligations of the Parties thereof in executing its objectives and shall not be constructed in any manner to refer to a relationship of partnership, agency or representation between them.

Article Twelve – Entire Agreement

This Agreement, including its Annexes, forms the entire understanding and agreement between its Parties with regards to its subject matter and extinguishes and replaces any previous understanding or agreement – whether written or not – that precedes it.

Article Thirteen - Notices and Addresses

Any notice required to be given in relation to this Agreement shall be deemed validly served if sent by return mail to the respective Party on the address stated hereinabove, unless a change of address has been so notified in writing.

Article Fourteen - Counterparts

This Agreement was made into two original counterparts, one with each of the Parties to act accordingly.

ANNEX A
LAND DESCRIPTION

ANNEX B
POWER GENERATION UNIT TECHNICAL SPECIFICATIONS

ANNEX C
POWER PRICE FORMULA

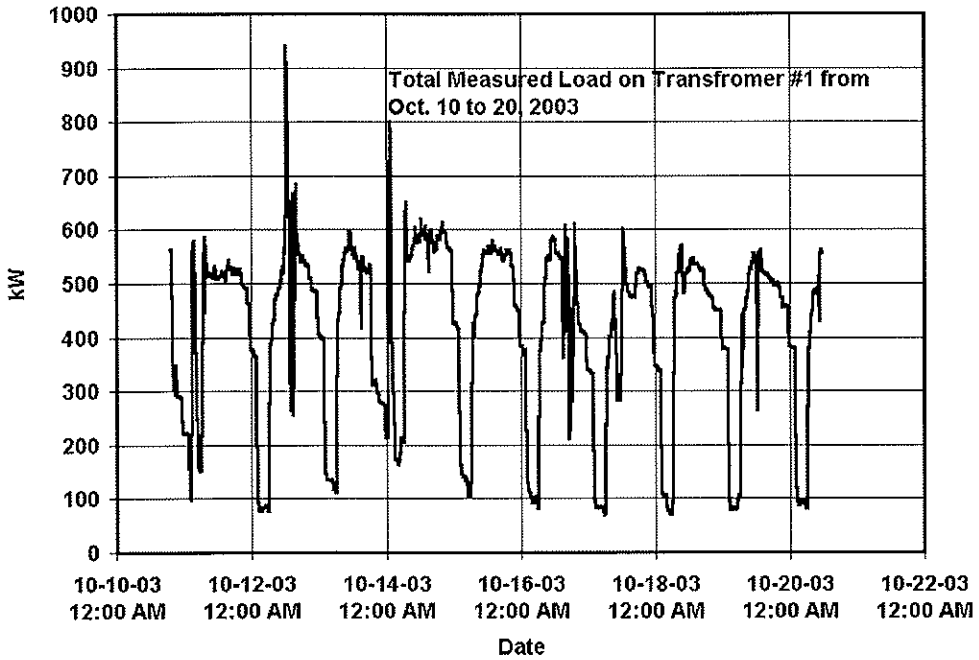
ANNEX D
MEASUREMENT AND VERIFICATION SPECIFICATIONS

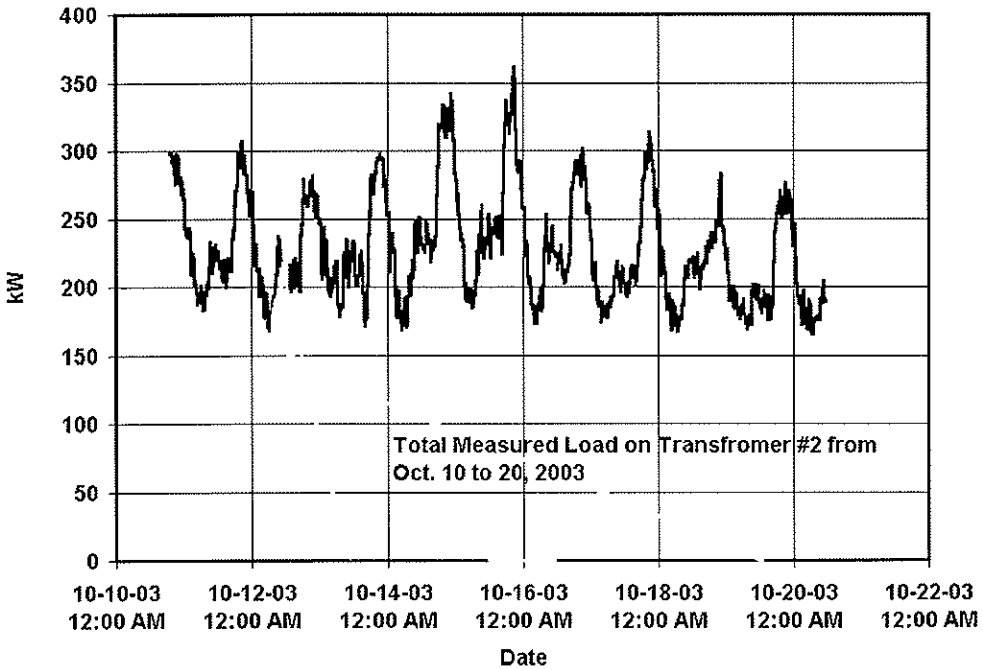
Appendix – Site Measurements Data

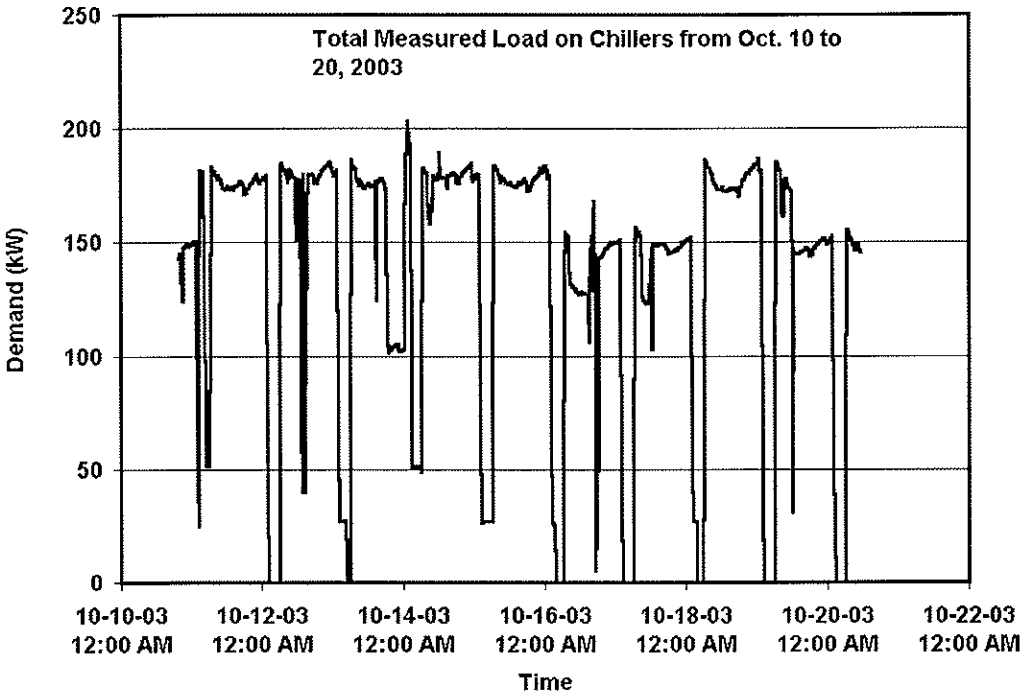
Summary of Site Measurements for Individual Loads and for the Total Load

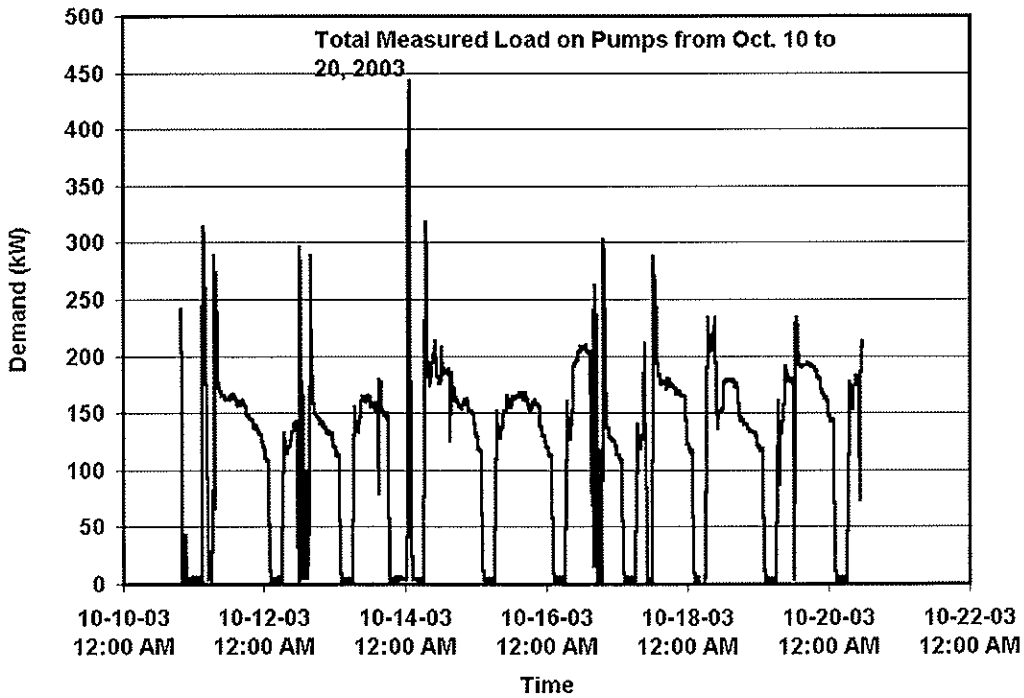
The maximum demand, the average demand, and the minimum demand for the individual load and the total hotel load for every day of measurements are listed in this table.

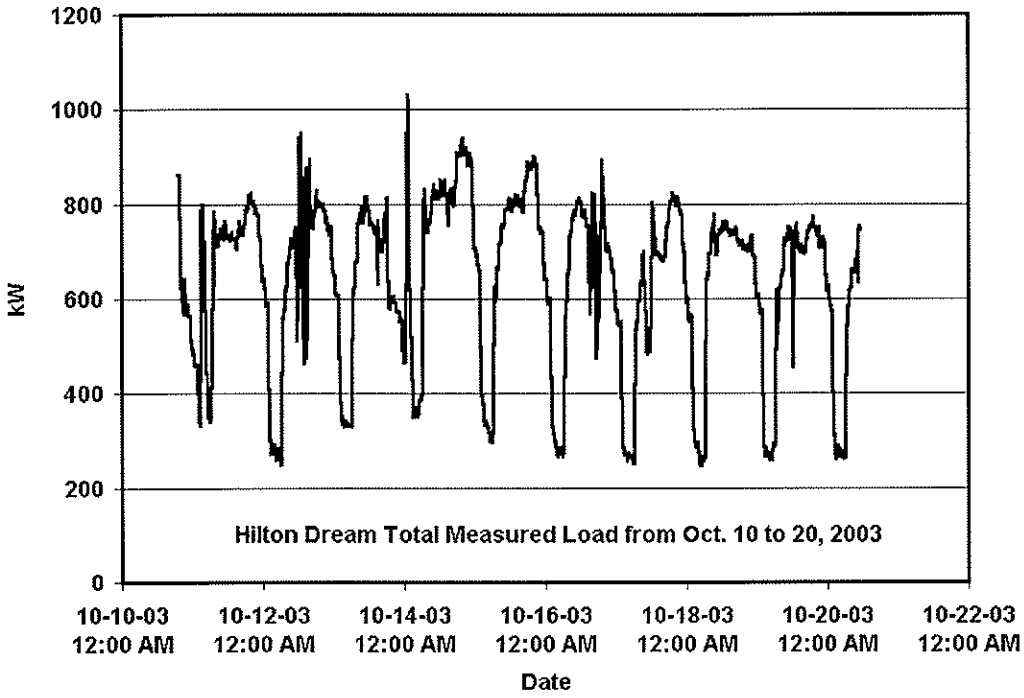
Measurement Date	Transformer # 1				Transformer # 2				Chillers				Pumps				Total			
	Demand (kW)			Load Factor %	Demand (kW)			Load Factor %	Demand (kW)			Load Factor %	Demand (kW)			Load Factor %	Demand (kW)			Load Factor %
	Maximum	Minimum	Average		Maximum	Minimum	Average		Maximum	Minimum	Average		Maximum	Minimum	Average		Maximum	Minimum	Average	
Oct 11, 2003	584	99	442	76%	306	183	231	76%	183	26.3	161	88%	313	2.48	132	42%	824	333	673	82%
Oct 12, 2003	938	77.7	422	45%	282	0	207	73%	185	0	137	74%	294	0	104	35%	949	249	629	66%
Oct 13, 2003	596	111	391	66%	298	172	228	77%	187	0	131	70%	180	0.98	89.2	50%	817	329	620	76%
Oct 14, 2003	798	164	501	63%	342	169	245	72%	203	48.8	158	78%	443	2.55	148	33%	1029	351	746	72%
Oct 15, 2003	580	104	441	76%	362	185	253	70%	184	26.3	150	82%	169	1.72	122	73%	903	299	694	77%
Oct 16, 2003	611	82.3	397	65%	301	173	232	77%	184	0	114	62%	301	0	123	41%	894	267	629	70%
Oct 17, 2003	598	70.3	376	63%	313	174	223	71%	157	0	118	75%	287	0.31	122	43%	825	251	599	73%
Oct 18, 2003	572	71.2	411	72%	284	167	214	75%	187	0	145	78%	234	0	131	56%	780	246	625	80%
Oct 19, 2003	562	79.2	406	72%	277	169	208	75%	187	0	128	69%	235	0	138	59%	773	259	614	79%

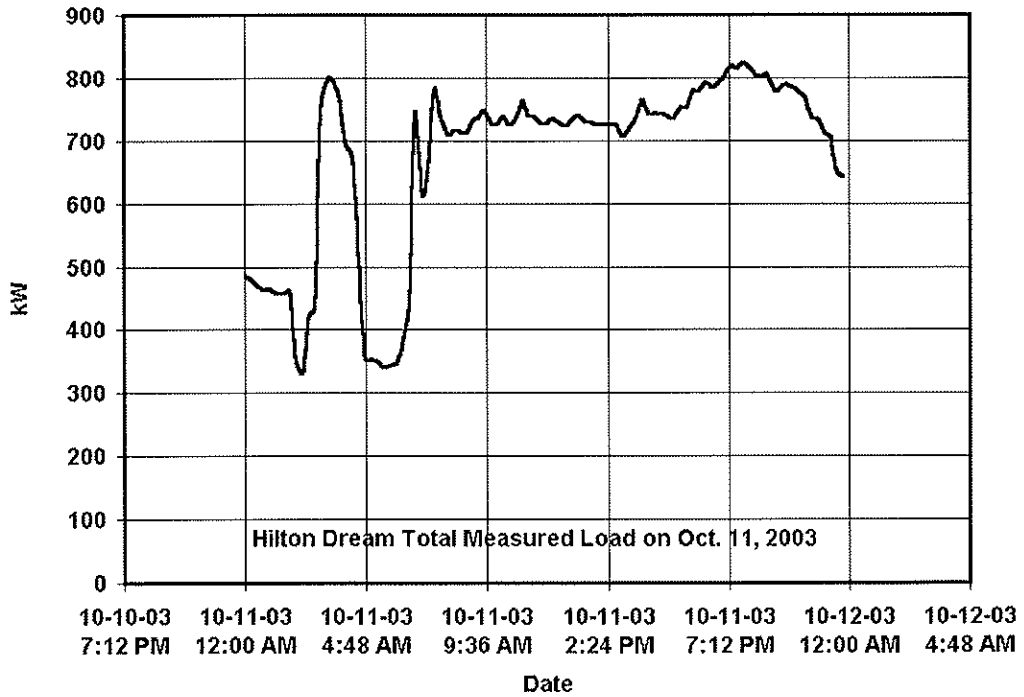

Total Measured Load on Transfromer #1 from Oct. 10 to 20, 2003
kW
1000
900
800
700
600
500
400
300
200
100
0
10-10-03 12:00 AM
10-12-03 12:00 AM
10-14-03 12:00 AM
10-16-03 12:00 AM
10-18-03 12:00 AM
10-20-03 12:00 AM
10-22-03 12:00 AM
Date

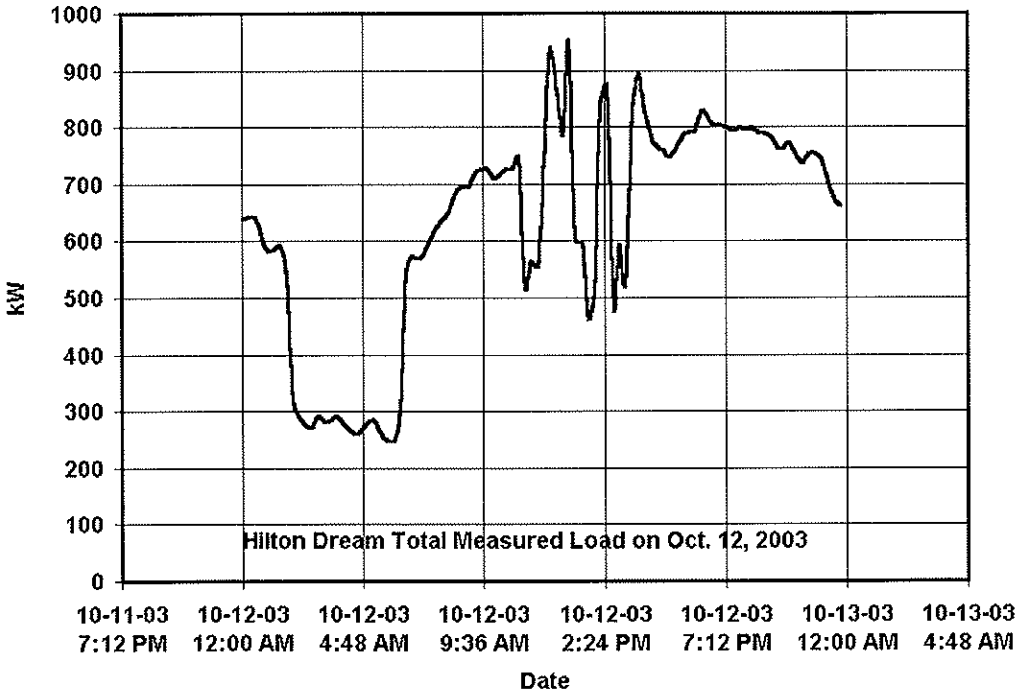

Total Measured Load on Transfromer #2 from Oct. 10 to 20, 2003
kW
400
350
300
250
200
150
100
50
0
10-10-03 12:00 AM
10-12-03 12:00 AM
10-14-03 12:00 AM
10-16-03 12:00 AM
10-18-03 12:00 AM
10-20-03 12:00 AM
10-22-03 12:00 AM
Date


Total Measured Load on Chillers from Oct. 10 to 20, 2003
Demand (kW)
250
200
150
100
50
0
10-10-03 12:00 AM
10-12-03 12:00 AM
10-14-03 12:00 AM
10-16-03 12:00 AM
10-18-03 12:00 AM
10-20-03 12:00 AM
10-22-03 12:00 AM
Time


Total Measured Load on Pumps from Oct. 10 to 20, 2003
Demand (kW)
500
450
400
350
300
250
200
150
100
50
0
10-10-03 12:00 AM
10-12-03 12:00 AM
10-14-03 12:00 AM
10-16-03 12:00 AM
10-18-03 12:00 AM
10-20-03 12:00 AM
10-22-03 12:00 AM
Time


1200
1000
800
600
400
200
0
kW
Hilton Dream Total Measured Load from Oct. 10 to 20, 2003
10-10-03 12:00 AM
10-12-03 12:00 AM
10-14-03 12:00 AM
10-16-03 12:00 AM
10-18-03 12:00 AM
10-20-03 12:00 AM
10-22-03 12:00 AM
Date


900
800
700
600
500
400
300
200
100
0
kW
Hilton Dream Total Measured Load on Oct. 11, 2003
10-10-03 7:12 PM
10-11-03 12:00 AM
10-11-03 4:48 AM
10-11-03 9:36 AM
10-11-03 2:24 PM
10-11-03 7:12 PM
10-12-03 12:00 AM
10-12-03 4:48 AM
Date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900
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700
600
500
400
300
200
100
0
kW
Hilton Dream Total Measured Load on Oct. 12, 2003
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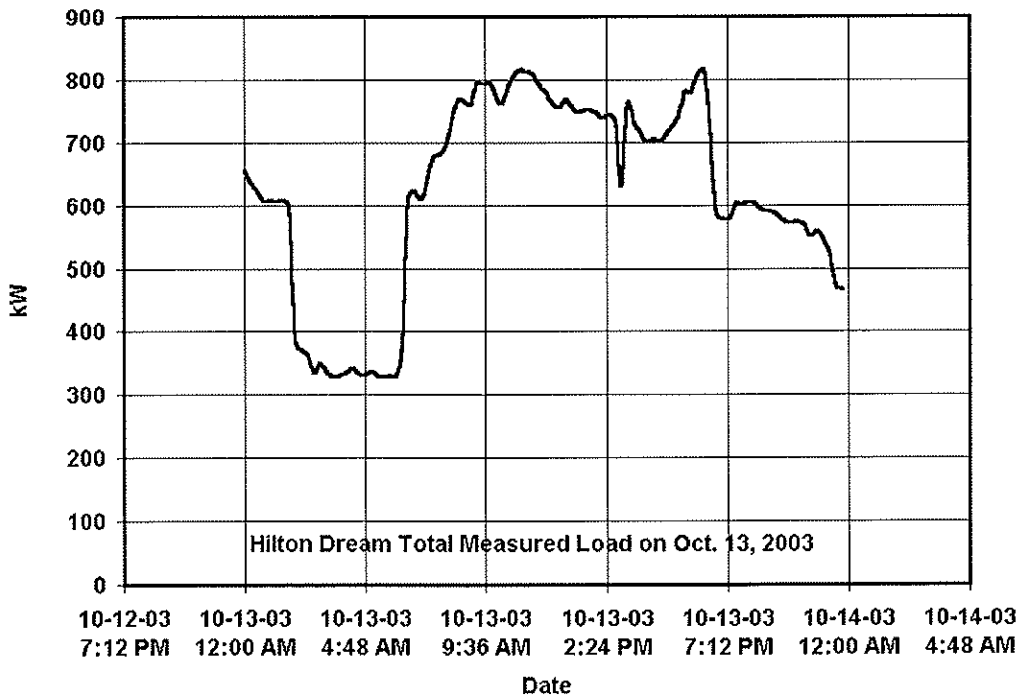
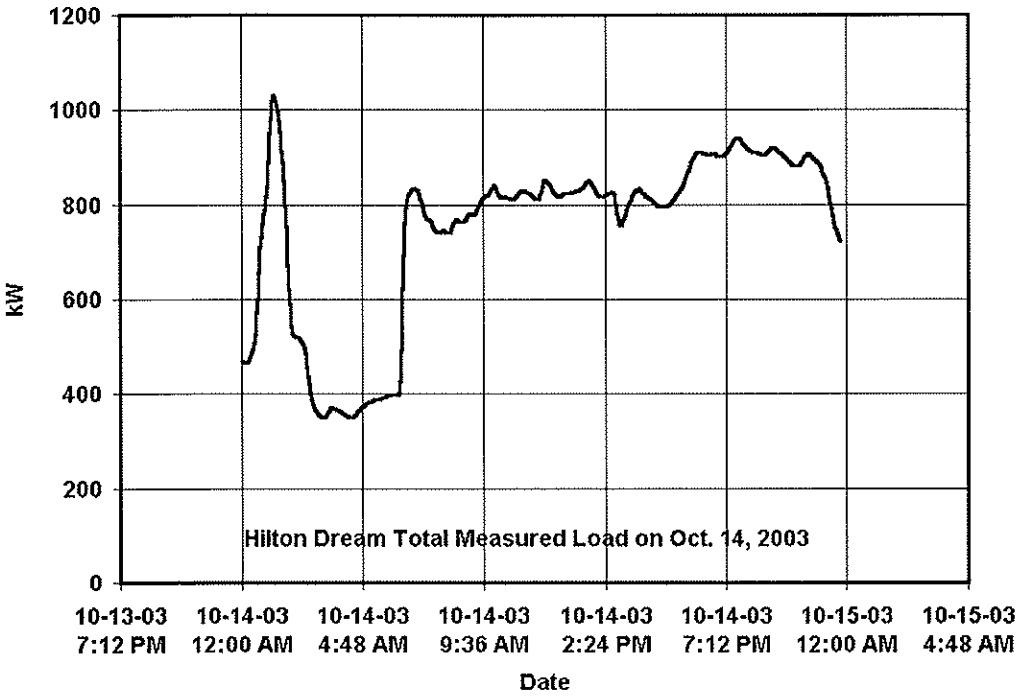
10-12-03 12:00 AM
10-12-03 4:48 AM
10-12-03 9:36 AM
10-12-03 2:24 PM
10-12-03 7:12 PM
10-13-03 12:00 AM
10-13-03 4:48 AM
Date


900
800
700
600
500
400
300
200
100
0
kW
Hilton Dream Total Measured Load on Oct. 13, 2003
10-12-03 7:12 PM
10-13-03 12:00 AM
10-13-03 4:48 AM
10-13-03 9:36 AM
10-13-03 2:24 PM
10-13-03 7:12 PM
10-14-03 12:00 AM
10-14-03 4:48 AM
Date


1200
1000
800
600
400
200
0
kW
Hilton Dream Total Measured Load on Oct. 14, 2003
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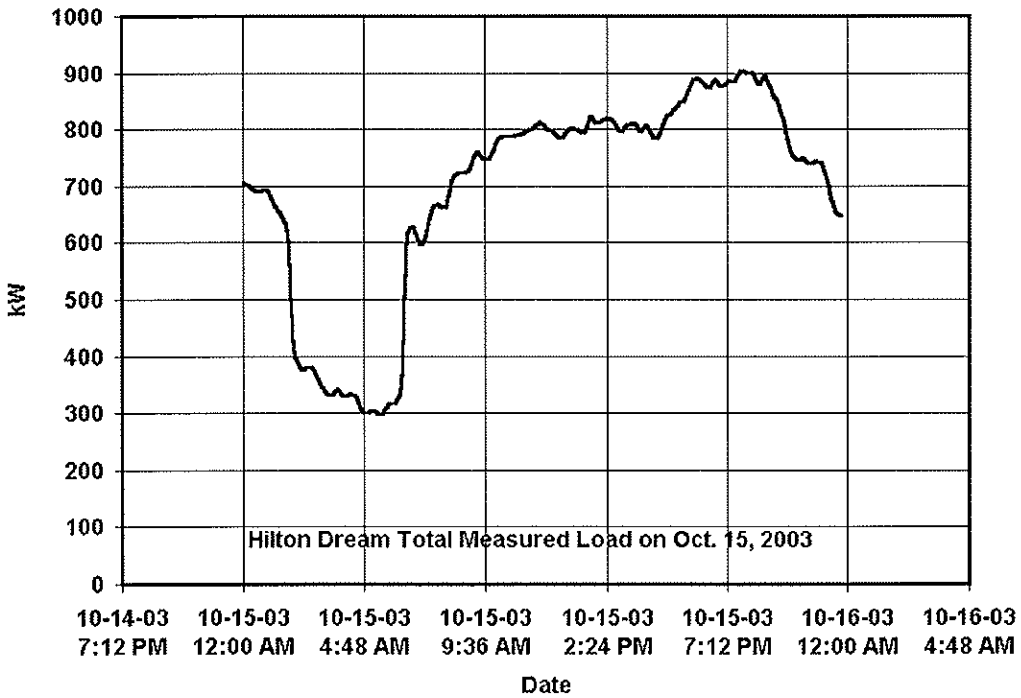
10-14-03 12:00 AM
10-14-03 4:48 AM
10-14-03 9:36 AM
10-14-03 2:24 PM
10-14-03 7:12 PM
10-15-03 12:00 AM
10-15-03 4:48 AM
Date


1000
900
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700
600
500
400
300
200
100
0
kW
Hilton Dream Total Measured Load on Oct. 15, 2003
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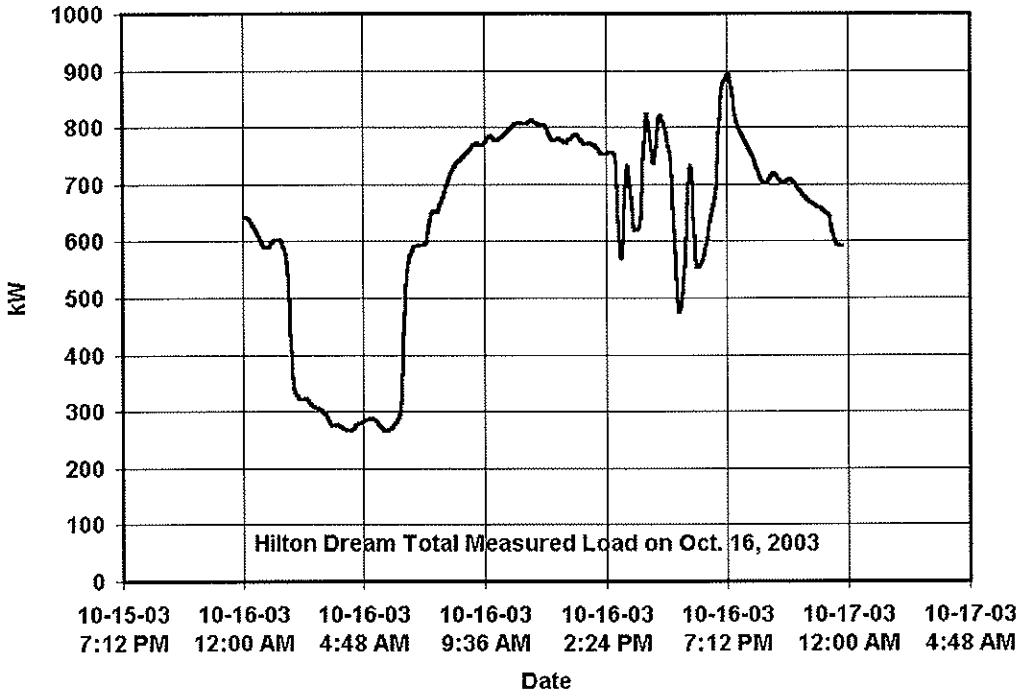
10-15-03 4:48 AM
10-15-03 9:36 AM
10-15-03 2:24 PM
10-15-03 7:12 PM
10-16-03 12:00 AM
10-16-03 4:48 AM
Date


1000
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800
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500
400
300
200
100
0
kW
Hilton Dream Total Measured Load on Oct. 16, 2003
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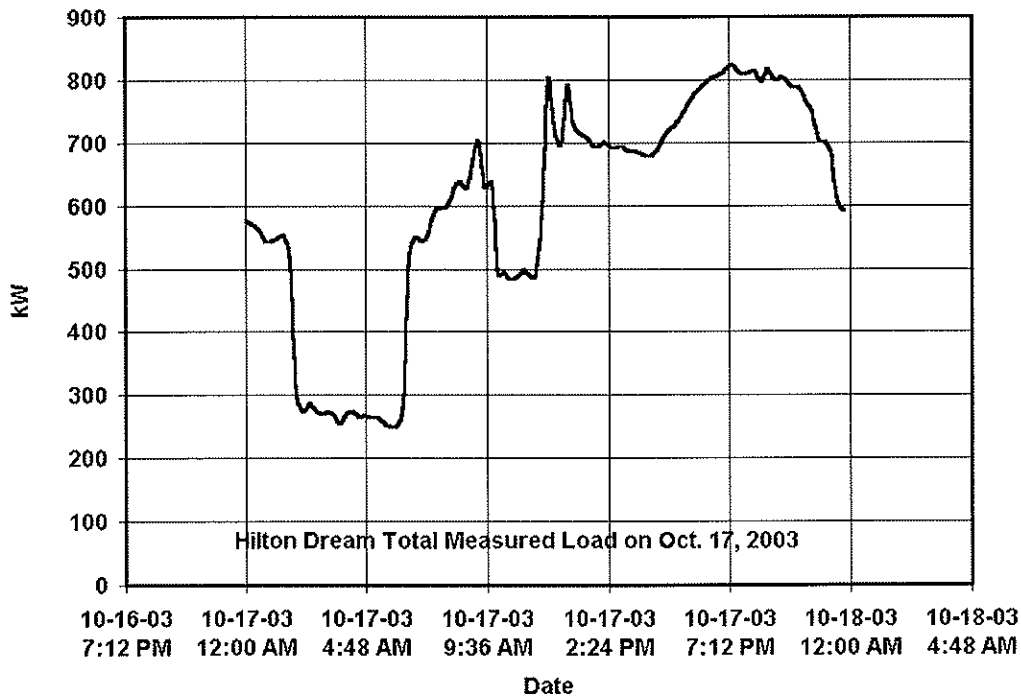
10-17-03 12:00 AM
10-17-03 4:48 AM
Date


900
800
700
600
500
400
300
200
100
0
kW
Hilton Dream Total Measured Load on Oct. 17, 2003
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10-17-03 4:48 AM
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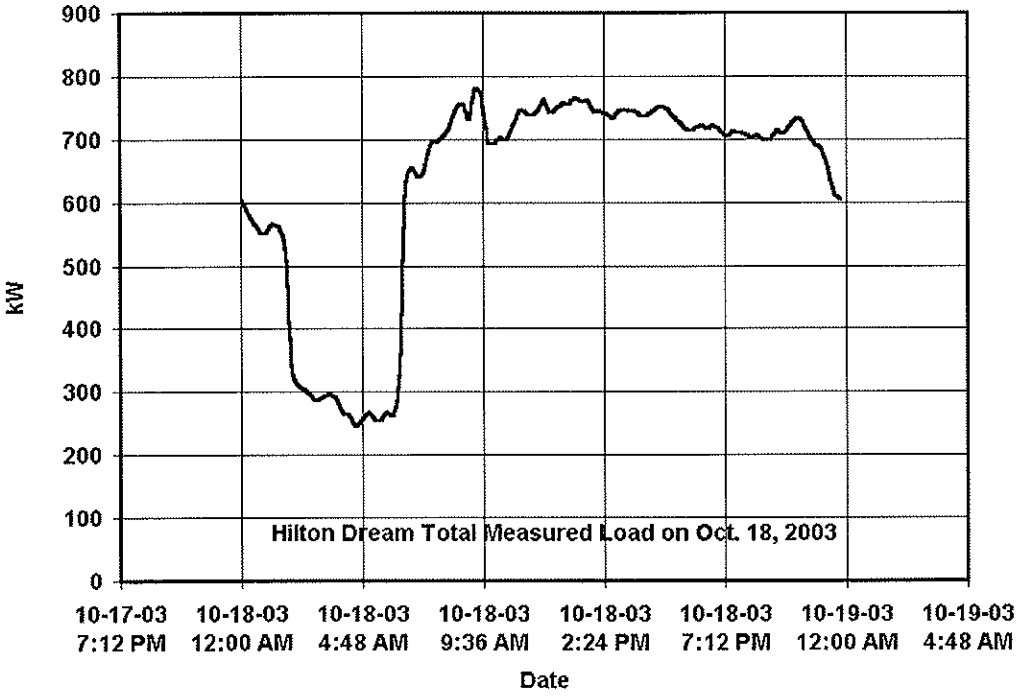
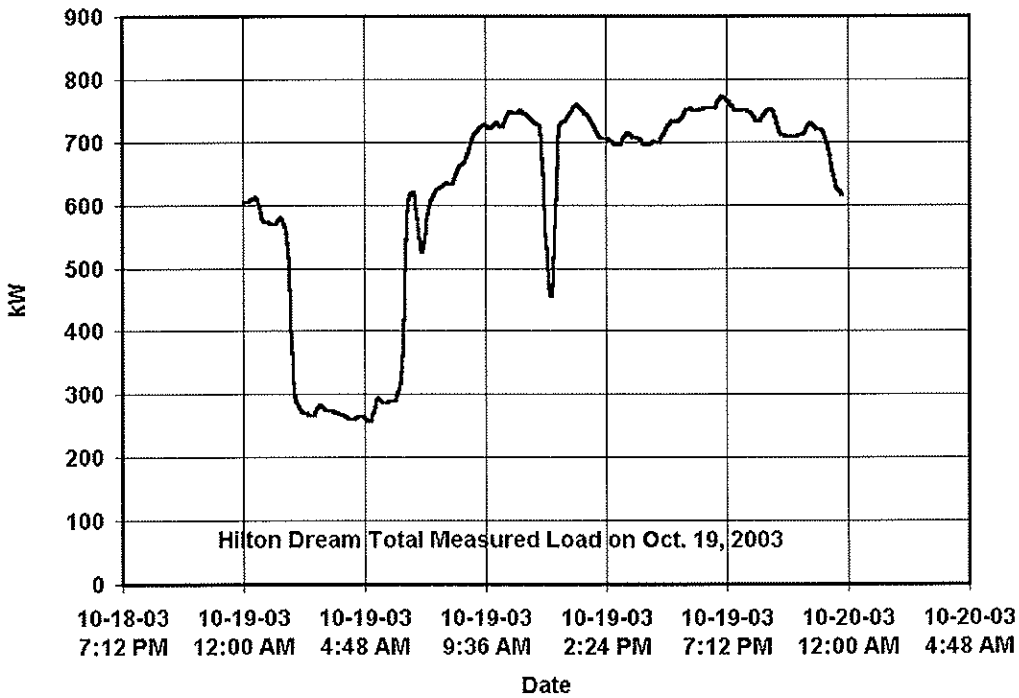
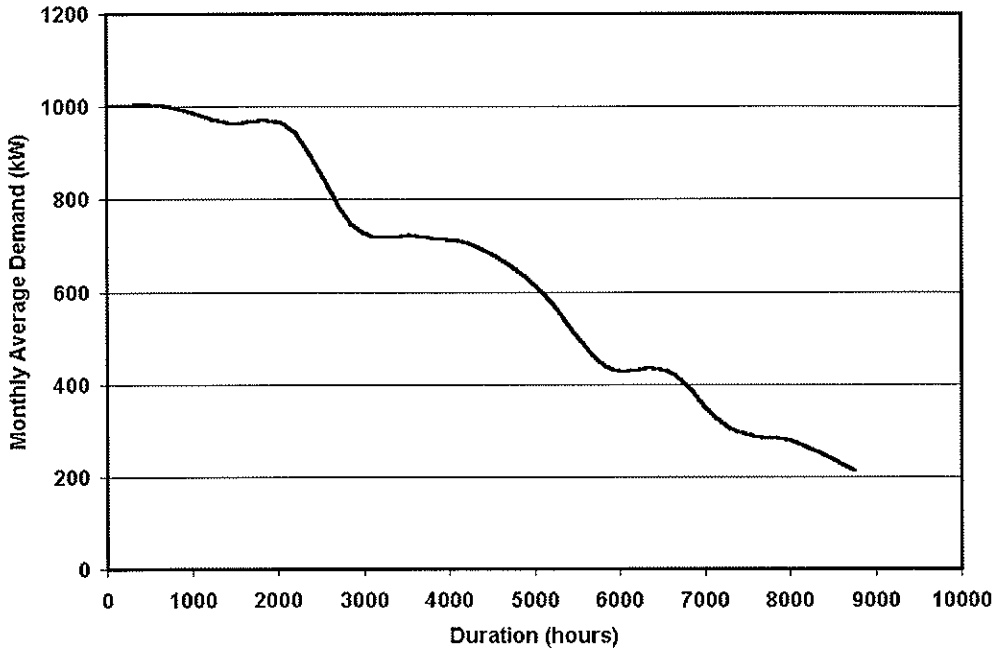
10-17-03 2:24 PM
10-17-03 7:12 PM
10-18-03 12:00 AM
10-18-03 4:48 AM
Date

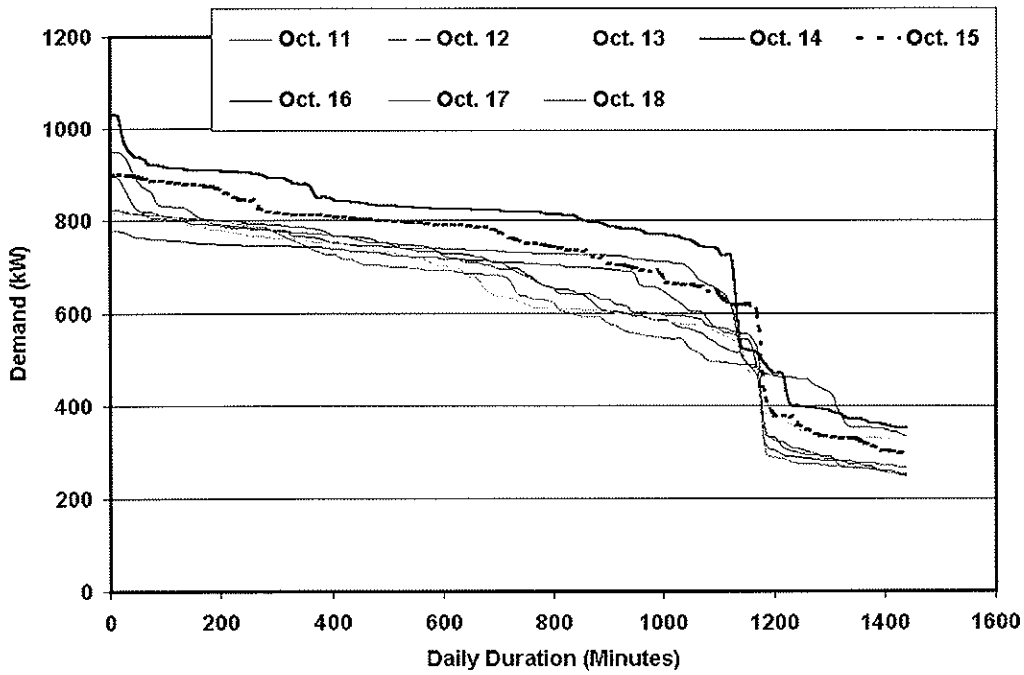




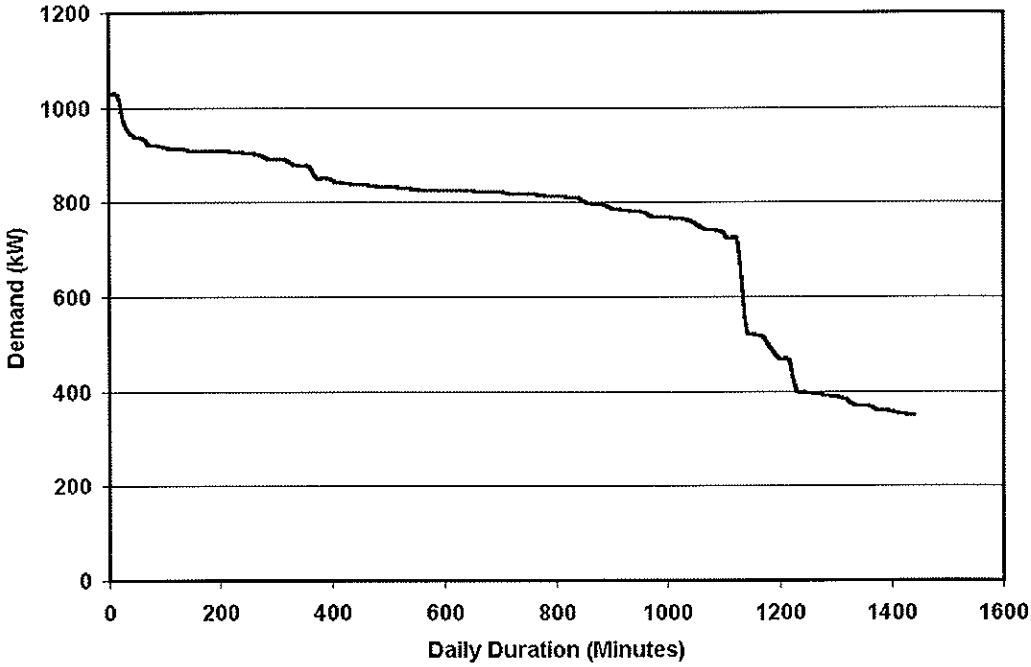
Hotel Load Duration Curve (form Utility Bills)

Hotel Load Duration Curve (form Utility Bills)

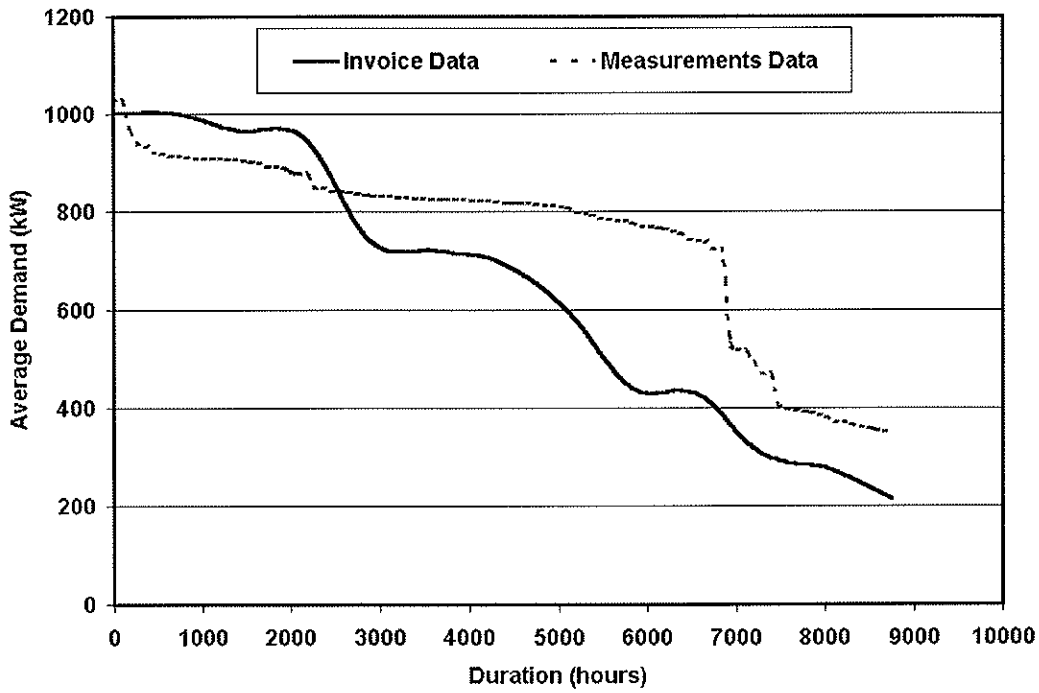




Hotel Daily Load Duration Curves (based on Site Measurements)



Hotel Daily Load Duration Curve of Oct. 14, 2003



Hotel Load Duration Curves based on Measurements and Bills